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INNOVATIVE RESIDENTIAL WATER AND WASTEWATER MANAGEMENT

Introduction

Most Canadian municipalities face problems related to water and wastewater services. It has been estimated that Canada will need to spend approximately 4 billion dollars annually over the next 15 years simply to maintain water and wastewater systems. This estimate could increase to account for anticipated expansion requirements.

The scarcity of capital, as well as the site and soil conditions within specific regions, has compelled many of these municipalities to consider innovative water and wastewater technologies as a means of addressing current infrastructure problems. Three of the more promising solutions include: wastewater recycling and reuse; rainwater cistern systems (RWCS); and water conservation.

For several decades Canada Mortgage and Housing Corporation (CMHC) has led many of the initiatives in residential water and wastewater management. This report is intended to provide an information and discussion source about innovative technologies in this area, and their potential applications in Canadian communities.

Research Program

The project involved an extensive review of the information in the Centre for Water Resources Studies' (CWRS) database, in addition to the information supplied by CMHC. Further information was obtained from public and private agencies; in Canada and abroad. All of the reference material was catalogued for future use.

Results

Current Situation

Fresh water is a renewable, yet finite, resource. Despite a supply that seems abundant, clean water may be in limited supply or inaccessible in specific locations at specific times of the year.

In Canada, water scarcity and other water related problems may be attributed to several factors. In some regions, human activity (deforestation, over-grazing, over-farming, or urban development) often directly leads to water shortages. Pollution from numerous sources may contaminate the groundwater on which more than one-quarter of all Canadians rely for their water supply. Current national trends indicate an ongoing population shift from water rich areas in the East to water deficient areas in the West. Canadians also appear to be leaving metropolitan regions in favour of small town and rural living. These tendencies are imposing increased demands on the available water supplies in such expanding communities. Gradual changes in climate as a result of global warming may have the potential to alter rainfall patterns, sea levels, and irrigation demands across the country.

The majority of Canada's current water and wastewater infrastructure needs improvement or replacement to meet existing and expanding demands. Thus, many Canadian municipalities now face, or will encounter, serious problems related to water supply and wastewater management. A discussion of the problems identified in specific regions in each province and territory is covered in Section 2. Among these concerns are:

- Water-poor regions with low precipitation;
- Groundwater with excessive concentrations of naturally occurring chemicals, such as salts and arsenic;
- Inadequate or malfunctioning on-site sewage disposal systems; and
- Increasing demands on water and wastewater infrastructure as a result of increasing population and population shifts.

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Each community could benefit from the implementation of one or more of the technologies addressed in this report.

Innovative On-Site Water and Wastewater Systems

The report considers three categories of innovative water and wastewater technologies that have been, or may be, used in single- or multi-unit residential buildings:

Rainwater cistern systems (RWCS) can provide an alternative or supplementary water source in situations where conventional sources are non-existent, inadequate, contaminated, or too expensive.

Water conservation can reduce demands on water sources or distribution systems. It can also reduce loads on wastewater collection, disposal and treatment systems.

Water reuse and recycling in residential, commercial, and industrial applications can reduce water demands and wastewater flows.

These technologies may be used alone or in combination to provide cost-effective alternatives to conventional services. In addition, they have the potential to address many of the water problems afflicting Canadian municipalities. These versatile solutions may be implemented at the level of individual buildings or entire municipal systems.

This section (Section 3) also introduces 17 case studies that illustrate applications of the three previously mentioned technologies in residential buildings. The majority of the case studies deal specifically with residential wastewater reuse and recycling. To reflect these solutions, detailed descriptions of 15 treatment components or systems are provided. These have been used, or have the potential for use, for wastewater recycling and reuse in residential systems. Each is described under the following headings:

- General description
- Principles of operation
- Status of technology
- Operation and maintenance
- Suitability to small flows
- Capital costs
- Effluent quality
- Utilization of local resources
- References (for additional information)
- Suppliers, contractors and consultants
- Conditions for successful use

Municipal Innovations in Water and Wastewater Management

Many Canadian municipalities have realized the potential of water conservation initiatives. These communities have been successful in reducing capital and operating costs of water and wastewater management. Section 4 presents examples of twelve communities that have invested significant effort in addressing specific water related problems.

A combination of several approaches was used to achieve many of the objectives outlined by each municipality. Among these initiatives were:

- New residential metering
- Industrial and residential water audits
- Low-flow fixture retrofit
- Public awareness
- Regulation of outdoor water use
- Computer database for program planning
- Infrastructure improvements

Although the solutions adopted by the 12 municipalities reflect circumstances unique to each community, the water efficiency initiatives employed may be extrapolated to regions with similar problems.

This section also explores examples of municipal wastewater recycling and reuse from around the world. These examples have been selected to illustrate reasons for the adoption of wastewater reuse, as well as to provide descriptions of how this wastewater has been used.

Implications for the Housing Industry

Section 5 draws on many recent references to review issues, obstacles and opportunities related to wastewater recycling and reuse. Successful implementation and use of the innovative technologies explored in this report will require the consideration of relevant concerns, in addition to careful planning. An outline of significant implications is given below:

1. The use of renovated wastewater for potable use in individual buildings is an alternative to be adopted with caution and care. Measures to ensure the safety of potable reuse must be considered.
2. Renovated wastewater may offer benefits for industrial uses, agricultural and urban irrigation, fire protection, toilet flushing, and other non-potable applications. Thus, the introduction of dual distribution systems should be considered.

Table 1. Objectives of water conservation initiatives undertaken by 4 of the 12 Canadian municipalities.

Municipality	Objective of Water Conservation Initiatives
Barrie, ON	Reduce average water demands in order to defer the need for an increase in the capacity of its wastewater treatment plant, and to defer construction of a new water treatment plant.
Edmonton, AB	Reduce water demands resulting from population growth, in order to defer capital expenditures for water treatment plant expansion.
New Glasgow, NS	Defer capital costs of additional water treatment, and to avoid the need to develop a new water supply.
Yellowknife, NWT	Avoid or defer capital costs to reduce operating costs for water supply, to increase the capacity of an already overloaded wastewater lagoon, and to reduce effects of water main leakage on street pavements

3. Incentives for use of reclaimed wastewater include reduced demands for potable water, reduced dependence on imported water, and reduced costs of water supply and wastewater disposal.
4. Concerns about public health implications of reclaimed wastewater reuse include must be addressed by the implementation of adequate water quality testing practices and safety measures.
5. Management of on-site systems will require regulations, technology, and public and private capacity to ensure long-term operation and maintenance of the system.
6. Creation of legislature, regulations, and criteria that specifically address wastewater recycling and reuse will facilitate the implementation of these initiatives.
7. Economic considerations, such as cost-benefit analyses, financing options, and pricing structures for reclaimed wastewater must considered prior to the implementation of any program.
8. Public acceptance of reclaimed wastewater will depend on the timing and quality of programs for public consultation and information.
9. Research and demonstration projects will be an important basis for public information, and for policy and planning decisions related to wastewater reuse.

This document is intended to serve as a resource for all individuals with an interest in the planning, design and management of water and wastewater systems. The examples provided in the report illustrate the need for innovative technologies in Canadian municipalities in order to prevent inevitable water shortages. Descriptions of the efforts undertaken by specific domestic and international communities may serve as guidelines for regions experiencing similar water related problems. The on-site systems and case studies introduced in this report may also provide viable solutions. Municipalities not currently experiencing difficulties with water and wastewater systems may also benefit from these technologies, as they have the potential to increase efficiency and reduce costs.

In any case, careful consideration of the issues and concerns related to each specific technology is required prior to the implementation of new programs.

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Research report: Innovative Residential Water and Wastewater Management, 1998

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A full report on this project is available from the Canadian Housing Information Centre at the address below.

Housing Research at CMHC

Under Part IX of the National Housing Act, the Government of Canada provides funds to CMHC to conduct research into the social, economic and technical aspects of housing and related fields, and to undertake the publishing and distribution of the results of this research.

This fact sheet is one of a series intended to inform you of the nature and scope of CMHC's research report.

The **Research Highlights** fact sheet is one of a wide variety of housing related publications produced by CMHC.

For a complete list of **Research Highlights**, or for more information on CMHC housing research and information, please contact:

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